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14. ABSTRACT

In a variety of industrial settings, investigators have used insights from human factors research to optimize the flow of complex work by improving teamwork, technology, training levels or the general work environment. We are using the same methodology to identify and address "flow disruptions" in trauma care in an effort to decrease risk and adverse events. We are using two methods to identify deviations: 1) surveys and focus group interviews of experienced care givers (qualitative measures) and 2) direct observation of care progression by trained observers (quantitative measures).

Qualitative measures: Survey results from 41 providers suggested positive attitudes to safety, with "speaking up" (71/100) and equipment (76/100) especially positive. Focus group interviews from 73 providers identified coordination (31%) and deviation from trauma protocol (20%) to be the primary sources of flow disruption. Quantitative measures: To date, observers have noted 278 flow disruptions in 12 cases and established coordination between patient care teams (29%), patient related delays (21%), communication (14%) and equipment issues (10%) to be the most common causes. The impact of observed flow disruptions was characterized as none to minimal (78%), moderate (14%) and full case cessation (1%), with the remainder categorized as unknown/missing. A sub analysis of one operative case found 78 disruptions due to patient related delays and coordination problems.

In combination, these qualitative and quantitative assessments build a picture of the complexity of trauma care and a systemic predisposition to error that is richer and more representative than any single source of data. Adverse impact from "flow disruptions" were seen in 15% of observed cases. Appropriate human-centered systemic interventions to reduce flow disruptions during the trauma process may help identify delays, inefficiencies and risks in patient care and improve trauma outcomes.

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Introduction

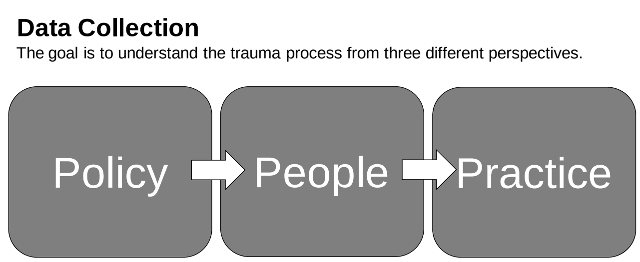
Our goal is to improve the efficiency and effectiveness of acute trauma care in both the civilian and military settings by introducing innovations in communication, technology, workflow, and behaviors. Research has shown that human error is unavoidable and that faulty systems allow such errors to cause harm to patients (Etchells et al., 2004). Through a multidisciplinary team of experts in process improvement, human factors research, and trauma care, we aim to improve the trauma system by detecting human error before a patient is harmed. We are currently engaged in documenting the efficacy of processes and technology in the full spectrum of peri-operative trauma care, from arrival, through surgery, to post-operative care. Through this project, we intend to contribute to an improved model ("should be" state) for trauma care in civilian and military hospitals.

Body

We seek appropriate solutions to real-world problems; to improve processes to address a need; to develop technologies to compliment the fundamentally important abilities of people. It was therefore important to our team not to fix something that was not broken, or to apply band-aids to solve a deep-rooted problem. The detailed study of the trauma system and the collection of data prospectively – to understand in depth how healthcare of the near future will look – are thus central in guiding us toward the largest opportunities in trauma care. The outcomes will define the specific metric(s) and interventions that we will pursue. Using both human factors and performance improvement methodologies, we began to collect data on the entire trauma process, from the time the trauma pager is triggered to when that trauma patient is transferred to the ICU, and everything in between. By piecing together all of the data elements collected, we aim to target our interventions in order to have the greatest positive impact on the process, and thus the most direct benefit for the future.

During the data collection phase (Aim 1, Tasks A – D), we focused on understanding the trauma process from three different perspectives. The first perspective was Policy: when looking at the official documents from the hospital, what is the process supposed to look like? The second perspective was People: when talking to those that live the process every day, what does the process look like from their point of view? Finally, the third perspective is Practice: what is actually happening when a trauma patient moves through the system and how does it compare to the other two perspectives? Understanding this difference between what should happen; what we think happens; and what actually happens is key to developing the systems that prevent or quickly resolve errors.

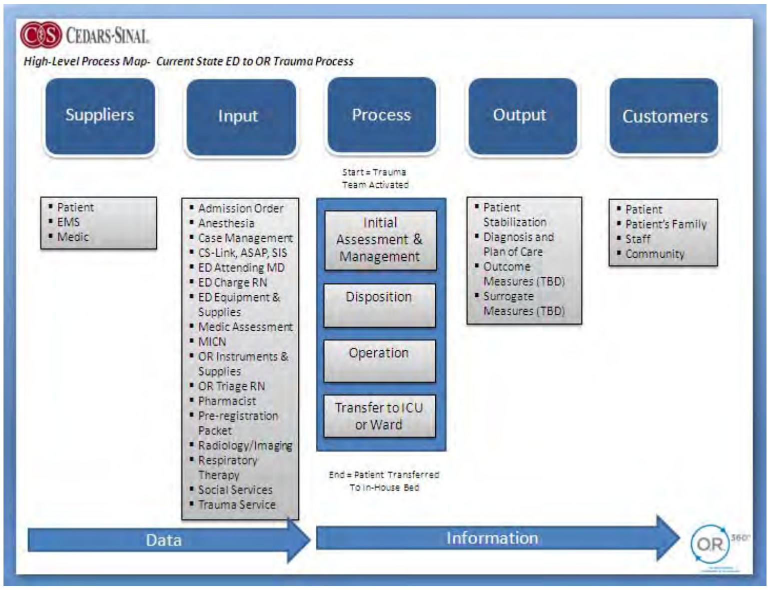
Figure 1: Data Collection Process Summary



Aim 1, Task A: process mapping using practice management guidelines

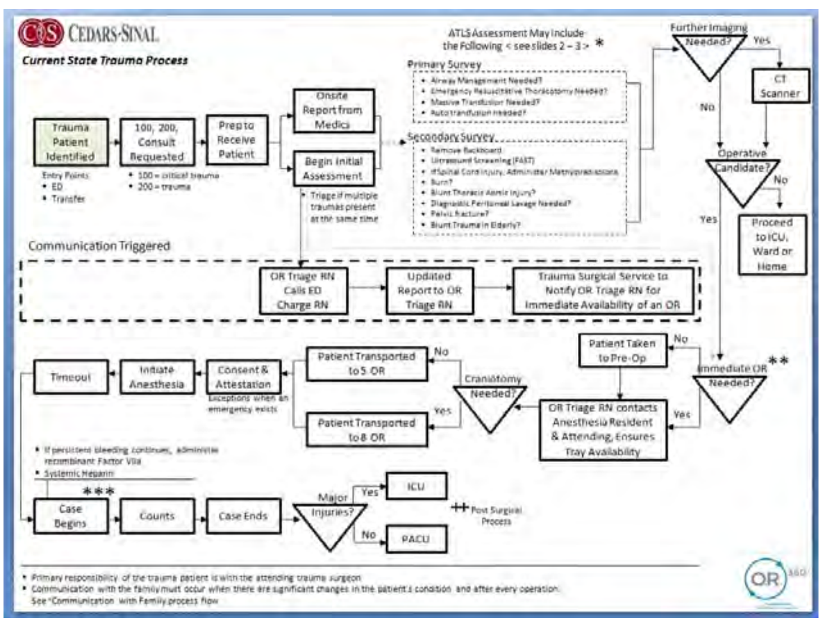
In developing the process maps, we reviewed trauma policies and procedures, trauma performance improvement and patient safety data (PIPS), trauma job descriptions, trauma training requirements, and standard trauma forms. The hospital has a large database housing hundreds of policies, each of which could be peripherally related to Trauma. In order to ensure the scope of the work was possible, the team agreed to limit the policies included in this deliverable to the ones written specifically for trauma patients and the general surgical policies related to safety (specifically, universal protocol, counts, and informed consent). This scope was then adapted as needed based on the identification of opportunity areas during the focus groups and prospective data collection. The first map below is a high-level SIPOC (Suppliers – Inputs – Process – Outputs – Customers) that highlights the major events that happen in the trauma process. Please note that full page versions of the process maps are available in the appendix (Appendix Document 1: Process Maps).

Figure 2: High-Level Process Map (SIPOC)



We then moved on to the creation of a more detailed map that includes all of the various steps listed in the policies and procedures. The map takes us from the starting point, when the trauma patient is identified, to post-surgery, when the patient is transferred to the ICU or PACU.

Figure 3: Current State Trauma Process Map



In the map above, there are two dashed boxes noted as the Primary and Secondary Survey. Depending on the specific patient injuries, different steps may be taken to stabilize the patient. All of the Primary and Secondary Survey steps noted in the policies and procedures are broken out on the gray background maps on the following page.

Figure 4: Primary and Secondary Survey Process Map - 1

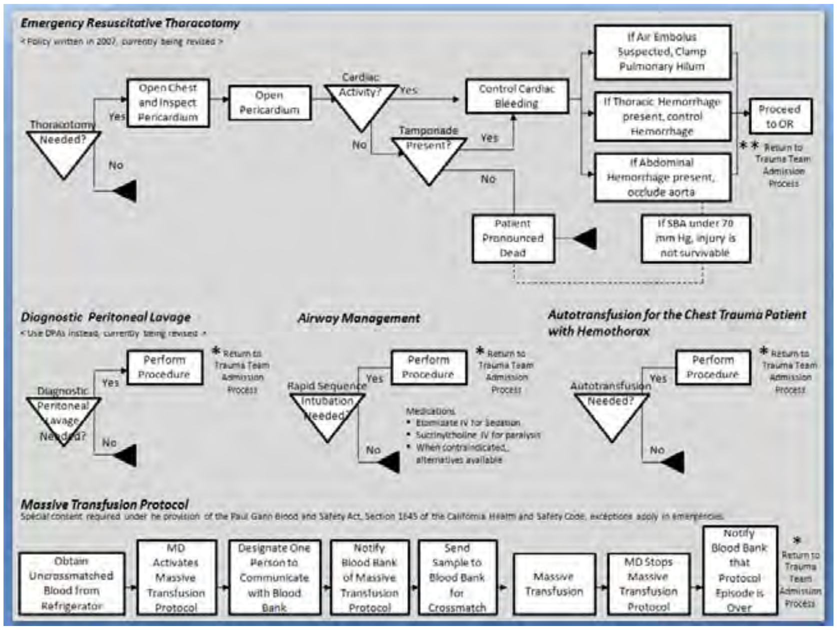
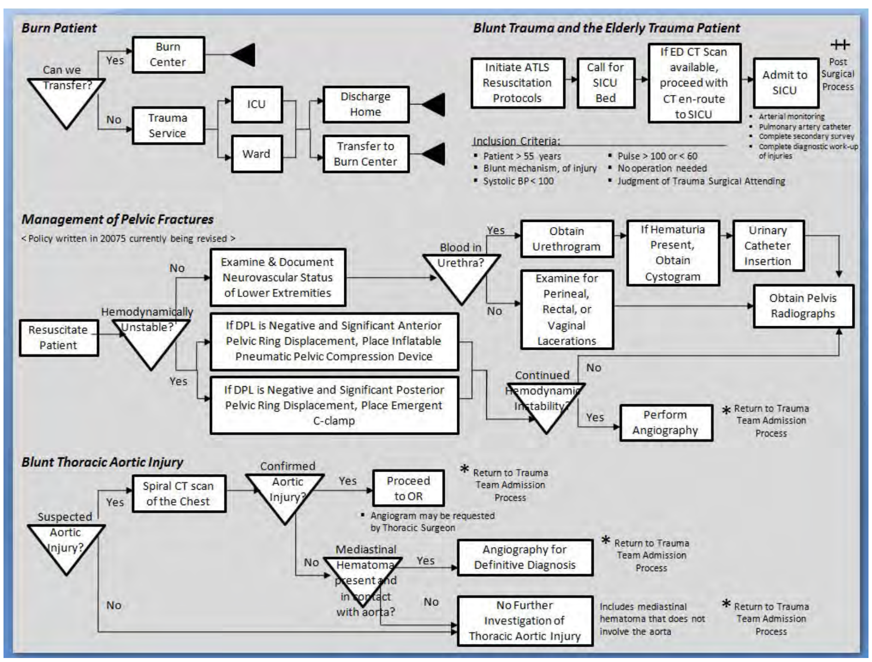
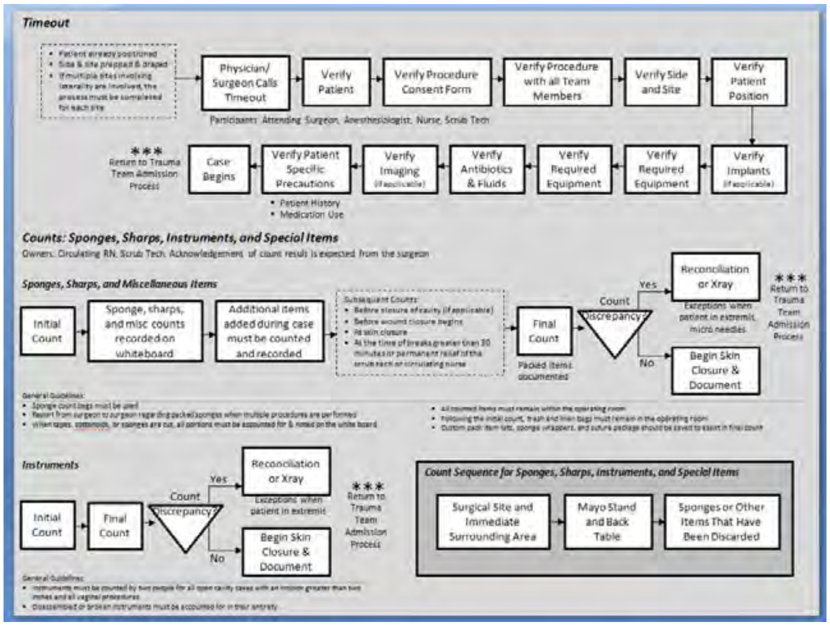


Figure 5: Primary and Secondary Survey Process Map - 2



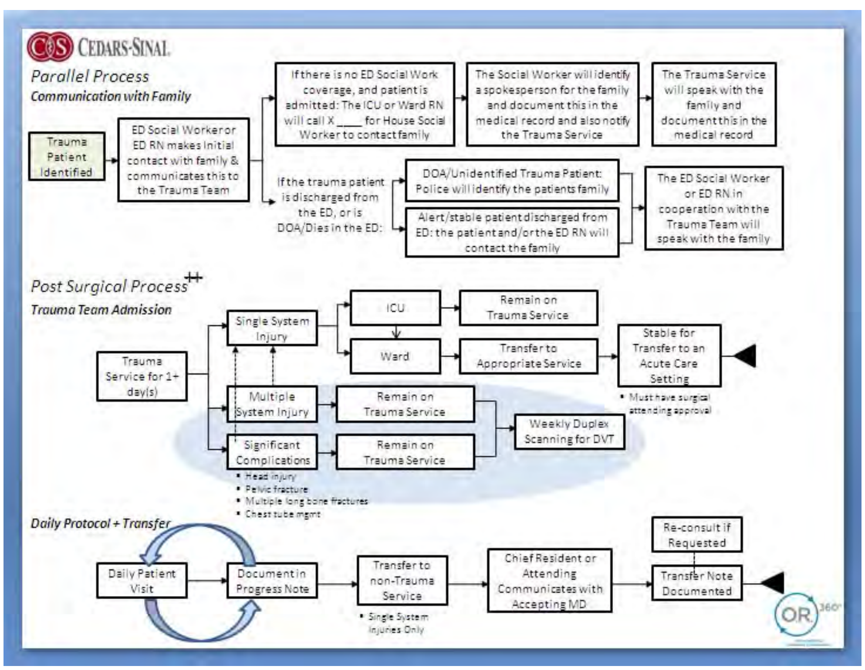
In addition, several hospital-wide policies pertaining to safety are applicable to trauma patients. The timeout process as well as the sponge/ needle/instrument count process is outlined below.

Figure 6: Timeout and Count Process Map



Throughout the initial patient assessment and the resulting trauma patient care, there is a separate, parallel communication process occurring with the patient's family, noted in the map below. In addition, once the surgical procedure is complete, the patient is added to the Trauma Service for daily follow-up.

Figure 7: Parallel Processes Maps



The process map step has not been completed for Madigan Army Medical Center. We are waiting for IRB approval at Madigan. Madigan completed their Trauma site survey on June 10th, 2011. Additionally, the Chief of Surgery, our primary contact, COL Rush, was deployed in Afghanistan from late May until late August. Now that the survey is complete and COL Rush has returned home, the Madigan team has more time to devote to facilitating the IRB approval and to this project.

The process maps will be used in conjunction with the observational data firstly to help distinguish between what should happen and what actually happens; and then as the basis on which to improve processes and integrate assistive technology in the intervention stages.

Aim 1, Task B: data collection on process deviations. Quantify adherence

A sub-team was put together to focus specifically on the interviews, focus groups, and Safety Attitude Questionnaire. The goal of this step was to understand the process from the "People" perspective and to begin to identify process deviations. It was determined that using the detailed process maps (as seen above) during focus groups would limit progress, as participants would get caught up in the details. To address this issue, we created a high-level summary of the process maps, highlighting key transition areas and known problem areas. The simplified map was used to drive the focus group discussion.

The sub-group developed a question guide for the interviews and focus groups. The guide contains the general areas of questioning that were covered:

Figure 8: Focus Group Questions Guide

Topic	Question
Identifying Process Deviations	▪ Review the high-level process map. Where does the process break down? (break down can mean systems, work group, roles, FTEs, delays, bottlenecks, bureaucracy) ▪ **Think of a trauma case that went really well. What made it go well?** ▪ **Think of a trauma case that did not go smoothly. What went wrong?** ▪ What types of things, related to safety, workflow, or quality, drive you crazy or keep you up at night? ▪ What frustrates you the most about working here? What would you do to change it?
People	▪ Who is in charge in the ED/OR when something goes awry? The nurse? The surgeon? Anesthesia? How well do anesthesia and surgery work together? ▪ **What makes a good trauma leader? What actions or behaviors does a good leader exhibit? What is different about what they do?** ▪ When it comes to physicians, how would you describe the relationship between you and them? What do you think they would say about you? ▪ What is the training process for an experienced [position of focus group members] who just transferred here from another hospital?
Technology	▪ How does technology help or hinder the trauma process?
Systems, Structures, Environment	▪ Are there any policies or procedures that affect patient safety that are consistently not followed? What do you do about it? What does your boss do about it? ▪ If you weren't telling us about these issues, who/how would you tell? Would you file an incident report? If not, why? ▪ What typically gets in the way of a new idea or practice?
General	▪ Complete this phrase "Working at ORGANIZATION is exciting for me because…." ▪ What has been the biggest positive change affecting patient safety? Why has it been successful? ▪ Is there anything we did not ask you that we should have?

We spoke to 73 people involved in the trauma process. Our discussions included 24 nurses, 14 doctors, 27 techs, three social workers, three case managers, and two pharmacists. A more detailed breakdown of the interview participants, by department, is noted below.

Interview and Focus Group Participants at Cedars-Sinai:

- Blood Bank 10 participants
- Case Management 6 participants
- Emergency Department 14 participants
- Imaging 3 participants
- Intensive Care Unit 7 participants
- Operating Room 6 participants
- Paramedics 16 participants
- Surgical Specialists 3 participants
- Trauma Team 8 participants

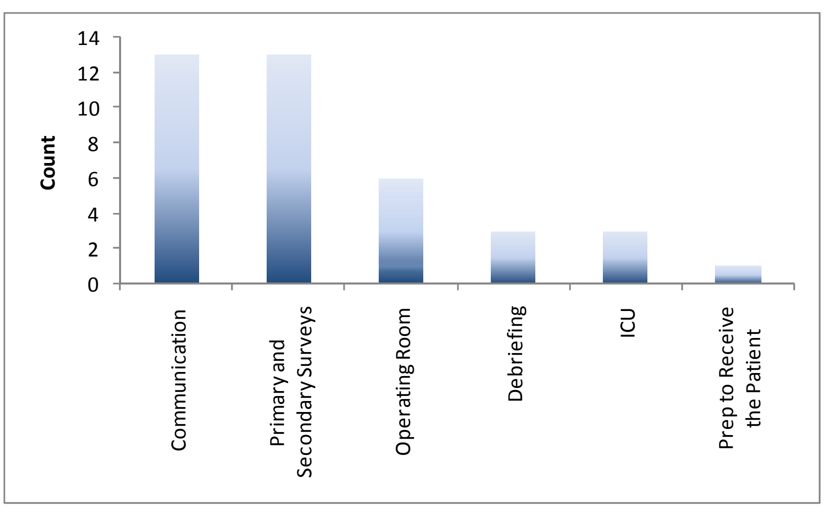
We talked to individuals along the entire continuum of care in order to better understand the process from multiple perspectives. The summarized responses are available below. Additionally, the detailed notes from the interviews and focus groups helped to inform the development of the prospective observations tool which will be discussed later in the report.

Figure 9: Word Cloud showing the key opportunities uncovered during the focus groups

When we did an initial analysis of the notes collected from the interviews and focus groups, there were two themes that dominated the conversations: communication and role confusion. These ideas came up at a high-level and the interviewers probed to uncover exactly what the participants meant when they mentioned these areas. With communication, the concern was that the communication channels were unclear. For example, staff did not know who was responsible for calling the blood bank or who was supposed to enter orders in the emergency department. There was confusion about whether the primary and secondary surveys had been completed during a trauma because the steps were not explicitly called out by the physician in charge. Finally, distractions, particularly in the form of superfluous noise, reduced the amount of information that is transferred from team member to team member during a trauma. The military experiences similar obstacles; the noise on the battlefield, with gunfire and helicopter protection overhead, can make communication very difficult.

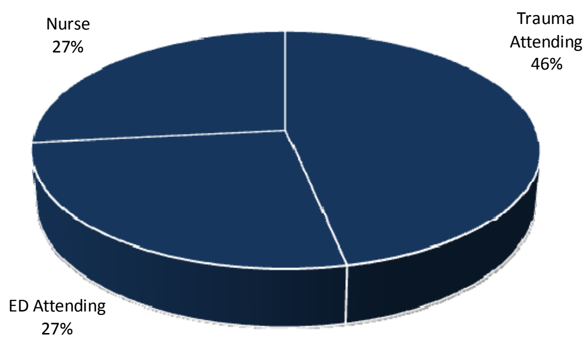
Role confusion was uncovered when we heard many people mention a “captain” or “leader” in their responses to our questions, but the majority struggled to give a specific title associated with the captain or leader. In other words, it was not clear who is, or should be, in charge of the room. When two attendings are in the trauma bay, one from the emergency department and one from trauma surgery, there was no clear rule for who is in charge. Similarly, in military trauma, roles and leadership may perhaps be unclear when mixing military ranks with the healthcare hierarchy. It will be informative to incorporate the findings from the Madigan interviews once they are complete.

Figure 10: If you could improve one step in the trauma process, what would it be?



Communication and the Trauma Surveys were mentioned most frequently. These two items were mentioned by 66% of the respondents.

Figure 11: Who is in charge in the ED and OR?



Clearly, there was confusion about who should be in charge of the room and the patient. The uncertainty stems from the communication opportunity noted above as well as a lack of clarity on when handoffs should occur between caregivers.

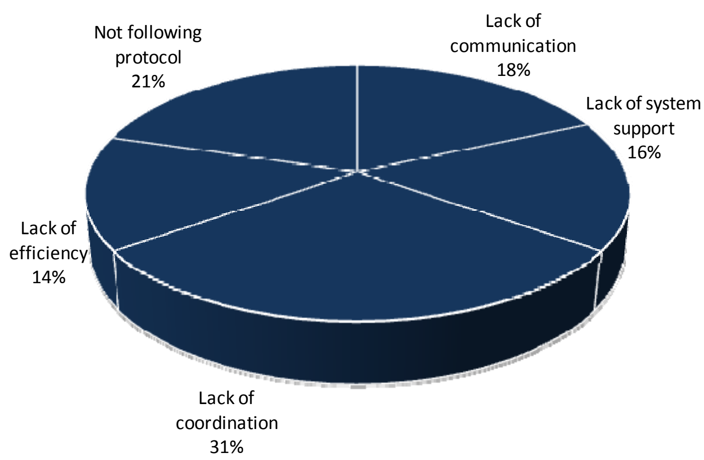
Figure 12: Think of a trauma case that did not go smoothly. What went wrong?

By asking the caregivers to walk us through specific cases, describing every step of the process, we were able to uncover detailed areas and themes that complicated the trauma process.

Figure 13: Think of a trauma case that went well. What made it go well?

Once again, specific case descriptions allowed us to get down to the details and confirm the elements of a case that are necessary to safely and efficiently care for a trauma patient.

Figure 14: What frustrates you the most about the trauma process?



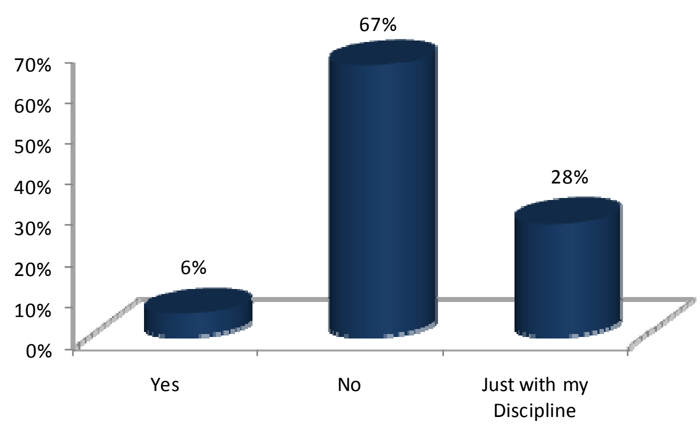
Out of all of the questions, we received the most feedback from this one. Caregivers could easily remember and recount the times when they were frustrated. The item noted the most was a lack of coordination among the various departments, specifically coordination among the ED, Imaging, OR, and the ICU.

Figure 15: What distractions and delays are present in the trauma process?

- Imaging
- Staff not available
- Unclear who should enter orders
- Trays and equipment not ready
- OR availability
- Finding supplies takes too long
- Availability of Trauma Attending
- Too many people
- Blood products

The distractions and delays mentioned by the interviewees quickly fell into a few high-level buckets, noted to the left. All of the items mentioned fell into our three areas of focus: people, technology, and the environment.

Figure 16: If something does not go well, does the team debrief after the case?

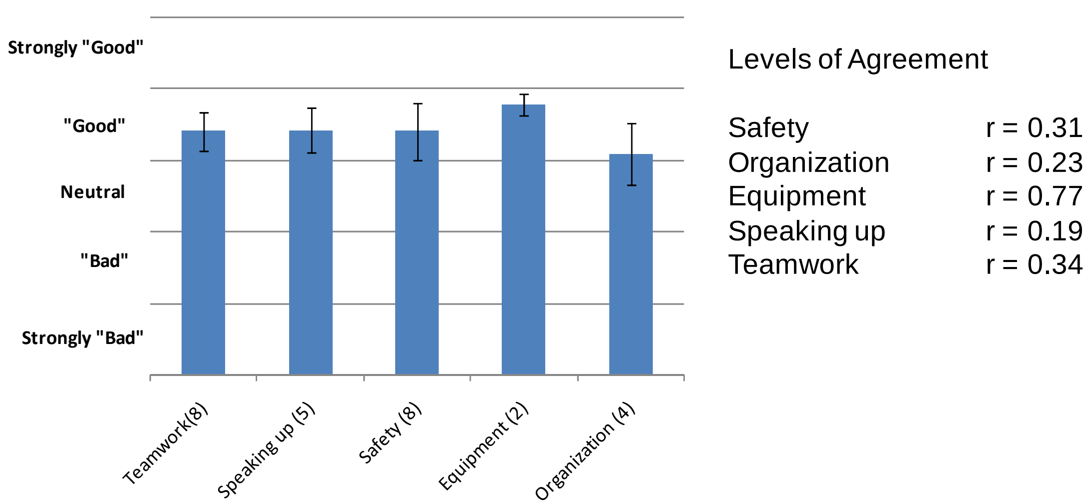


The majority of those interviewed did not participate in team debriefings. The people that did debrief did so with their own discipline. It is a very rare occurrence when the entire multi-disciplinary team came together to discuss and learn from a case.

This result is important but not expected, since debriefing may be a central component of quality improvement, learning, and coping with stress – yet in mainstream healthcare it is frequently omitted, and nearly never conducted as a a team. Here, we also see a strong tie to Landstuhl Regional Medical Center (see Landstuhl Visit summary later in the document). Our visit to Landstuhl included a discussion of After Action Reviews and the Resiliency Team. The Resiliency Team is in place to help the medical team deal with all of the trauma and loss that they witness in addition to learning from each of the situations. We felt it to be an excellent program that a civilian hospital could learn a great deal from. Debriefings are a key learning and coping tool and they can always be improved. We suspect two barriers to debriefing are having the time, and ensuring feedback and resulting action occurs, so we are interested in taking this on to develop smarter and better ways to debrief, and technology tools that will assist in the management and propagation of debriefing outcomes. This may be of direct interest and benefit to Landstuhl.

We administered a Safety Attitude Questionnaire to 41 healthcare workers at Cedars-Sinai Medical Center in order to assess the current safety culture. The questions were categorized into five domains: Equipment, Organization, Safety, Speaking Up, and Teamwork. Results from the completed surveys are summarized in the graph below. The trauma team tends to have a positive attitude towards safety and show especially high scores and agreement on equipment.

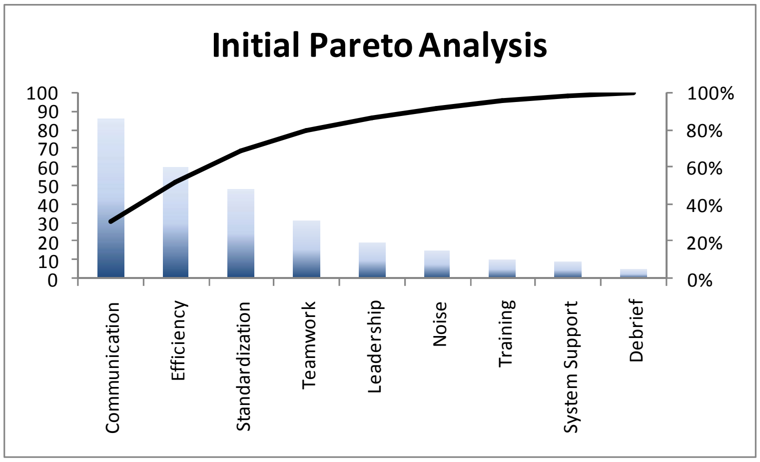
Figure 17: Safety Attitude Questionnaire Results



Aim 1, Task C: identify process deviations, attributing deviations to people, technology, and the environment

We developed a Pareto chart based on the information we have gathered to date. The themes cut across all three of our areas of interest, specifically people, technology, and the environment. We have included definitions for each bar, pulling the definitions directly from our data-to-date. The Pareto will be updated when we are able to collect data from Madigan Army Medical Center.

Figure 18: Pareto of Process Deviations



Communication

speak out loud when conducting the surveys, give the OR a heads up that you are coming, better communication among the various specialty teams, it would be nice to learn about the entire trauma process, reliable information from the field, verbally review what everyone is doing, we gave back the trauma pager b/c it didn't tell us anything

Efficiency

getting an operating room is a problem, better placement of supplies, add propofol to the pyxis, trauma cart available, dedicated trauma bay, samples sent to the wrong lab, lab instruments down, this place moves supplies all of the time, elective cases are in the scanner, waiting for a transporter, PACS in the trauma room but have had problems with the plain films coming up too slowly, waiting for blood

Standardization

stop doing emergent cases at night, primary survey needs to be more automatic, have a family conference within 48 hours, we used to have three tiers of trauma and it worked better, nobody called for a massive transfusion protocol, peds patient cared for in adult ICU, the surgeons like to skip steps

Teamwork

it would be nice to know the names of the people we are working with, interference from observers – no one took charge and told them to leave, proactive, doctor signed off on the Medi-Cal pending paperwork very quickly, great anticipation by everyone

Leadership

surgeon communicated a plan of care, involved the entire team, Sue in the ED is aggressive and she keeps us informed, decisive, no yelling, took charge but was collaborative, the attending had a plan and it meant the team was prepared, totally uncoordinated

Noise

confusion, many people involved, crowd control, doctor were yelling

Training

SICU nurses used at another hospital, people understanding their roles, techs are trained in many different specialties which is helpful, residents do not know the correct order of things sometime our proficiency of equipment use is slow b/c we don't use it often

System Support

trauma is an inconvenience to everyone but the patient and the trauma surgeon, Cedars doesn't have a different pace for trauma

The researchers have already noted a difference between that which is written in the policies and the perceptions of what happens in reality. We hope to address this in much more depth when we have the results of the prospective observational data collection.

Aim 1, Task D: conduct prospective data collection

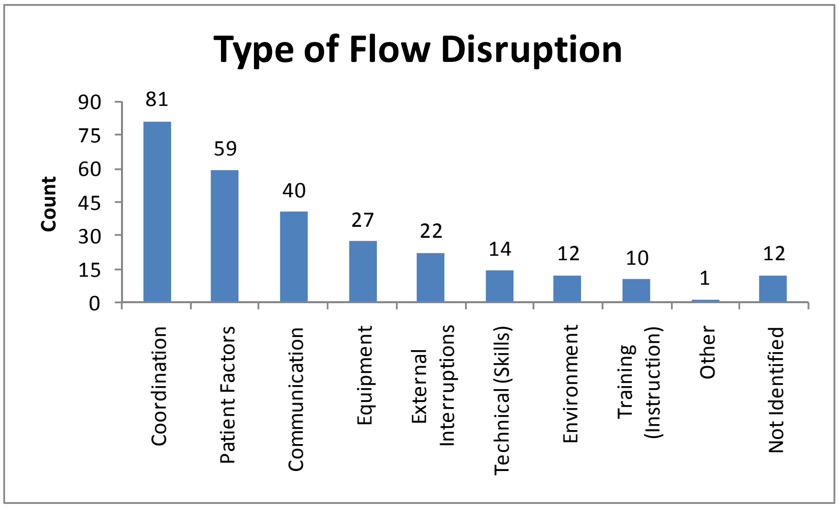
Surgical flow disruptions are events resulting in a pause during the primary surgical task, or a loss of any team member's situational awareness. There is an empirical link between flow disruptions in the operating room and surgical errors (Wiegmann, 2007). From the systems perspective, flow disruptions are a symptom of a latent failure somewhere within the system. Gaining a better understanding of the frequency and nature of flow disruptions allows for the development of evidence-based interventions (Wiegmann, 2006). Flow disruptions collected in a single case hold little validity for indicating system failures because there are many variables such as team member personality and individual patient factors that influence the progression of any specific case. In contrast, flow disruptions that indicate systemic failures will resurface across cases, revealing areas that warrant further investigation. Some benefits of flow disruptions as a metric include; the ability to capture systemic failures of any type, the ability to acquire a baseline measure that can be used

Based on the information obtained through the process maps and the interviews, our human factors collaborators modified a PC data collection tablet in order to capture flow disruptions (Appendix Document 2: Tablet PC Data Collection Tool Screen Shots). We have engaged six medical students and two PhD candidates to conduct the trauma observations. The observers were trained by human factors experts as well as crew resource managment experts in order to help them identify key flow disruptions that occur during trauma cases.

Trauma teams activated for high level traumas are being studied to determine the frequency, cause and impact of flow disruption. Observers follow patients from the ED to ICU, ward, or discharge. Particular focus is given to patients who go directly to the OR. We are collecting data on the number, type, timing, and severity of flow disruptions.

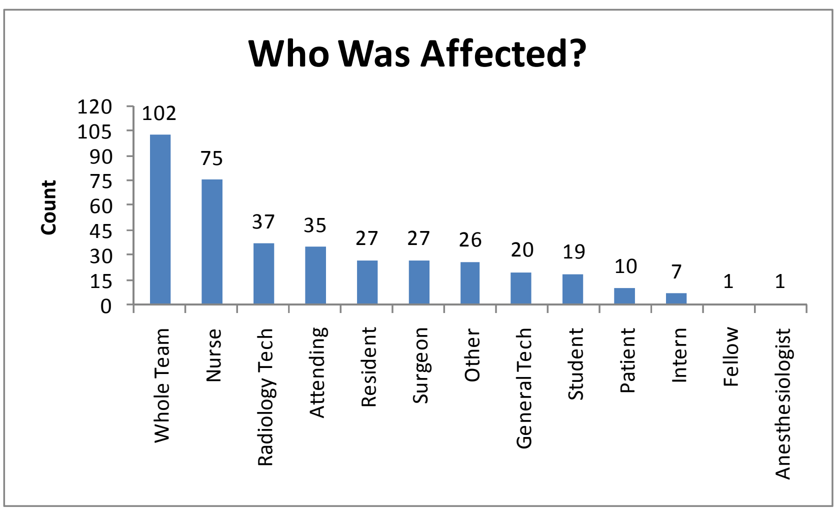
To date, observers have noted 278 flow disruptions in 12 trauma cases. The most common disruption is coordination among patient care teams (29%), followed by patient-related delays (21%), and communication (14%). A sub analysis of one operative case found 78 disruptions due to patient related delays and coordination problems.

Figure 19: Flow Disruptions Observed During 12 Trauma Cases



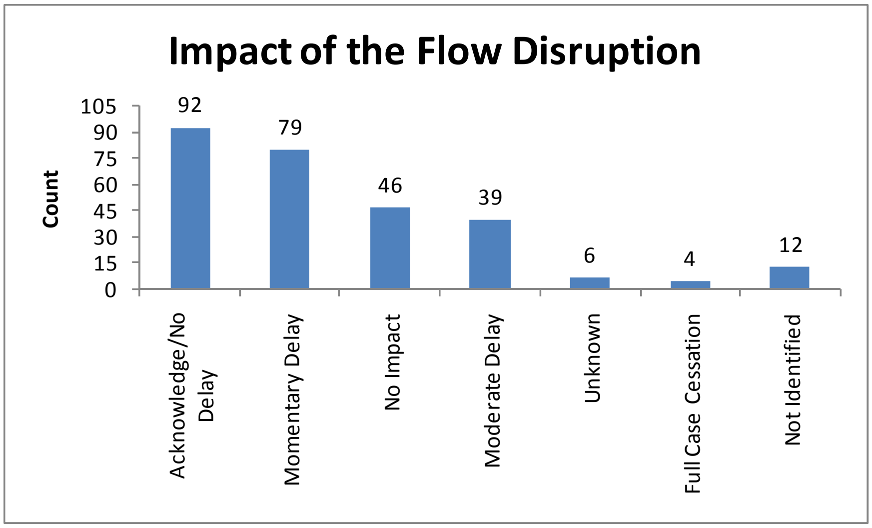
The observers also recorded the role that was impacted by the flow disruptions. Most commonly, the entire team is affected by the disruption (26%), followed by the nurse (19%), and the radiology technician (10%). Please note that multiple roles can be affected by one flow disruption so the total (387) is higher than the number of flow disruptions.

Figure 20: Role Affected by the Flow Disruptions Observed During 12 Trauma Cases



The impact of observed flow disruptions was characterized as none to minimal (78%), moderate (14%) and full case cessation (1%), with the remainder categorized as unknown/missing.

Figure 21: Impact of the Flow Disruptions Observed During the 12 Trauma Cases



We have had several debriefing sessions with the student observers to address concerns that have arisen, refresh on observational objectives, and collect insights that they have uncovered through the observations. The medical students' perspective has been an asset to our team as they offering a perspective on the process that is free of personal and cultural biases. It is particularly encouraging that their early reported experiences directly reflect the experiences and results from observers in similar studies.

Though it is very clear that the students are excellent observers of flow disruptions, their lack of clinical expertise may impede their ability to pick up clinically relevant factors that impact a case. In order to address this concern we have incorporated our anesthesia fellows into the observational process. The fellows will be observing alongside the students during a proportion of cases, allowing both comparison between experienced and unexperienced medically trained observers, but also allowing reliability testing that will ensure the level of error in our measurements can be accurately tracked and thus scientifically validated and sound.

Visit to Landstuhl Regional Medical Center

To better understand the military trauma process and to hear first-hand about the types of improvements that could make a difference at Landstuhl, our project manager took the opportunity to visit Landstuhl, Germany in March 2011 during another European assignment. She was in Italy working on her Master's thesis and decided to make the short trip up to Germany to meet and talk to the Landstuhl team. The intent of the trip was She spoke to multiple team members involved in the trauma process including: Insel Angus, ICU RN; LTC Raymond Fang, MD, Trauma Medical Director; MAJ Kenny Harryman, RN, Head Operating Room Nurse; Connie Johnson, Trauma Coordinator; Kathie Martin, RN, Trauma Program Director; and LTC Lisa Toven, OR RN.

Landstuhl was a Level II Trauma Center at the time of the visit (as of Fall 2011, they are now a Level I trauma center) with eight operating rooms and 12 intensive care unit beds. The most common injuries seen were neck and lower extremities. The average soldier length-of-stay was three days. Landstuhl functions with a diverse, transient team that includes Air Force, Army, Navy Reserves, and local civilians.

We asked the Landstuhl Trauma Team what they would do to improve the trauma process and they had many insights to share with our research team. In an ideal setting, everything would be available at the point of care, standardization would be more prevalent, and technology would be better utilized to improve efficiency and outcomes. The details that were shared under each one of these categories is summarized on the following page.

Everything at the Point of Care

- Don’t like dragging in towers for lap procedures
- Pathologist involved in the case to identify fungi spores in the OR, keep count of fragments
- Neptune system that can hold up to 20 liters of fluid
- Better lighting

Technology

- Mounted video equipment
- Everything should be wireless, touch screens, direct connection to other hospitals
- Immediate lab results available on a screen in the OR

Standardization

- Standardized ORs throughout, any case can be done in any room
- One person needs to be in charge of the room
- Resuscitations should be done in the OR (or a room specially designed for resuscitations)
- Everything off the floor / everything should come from the ceiling. A company in San Diego designed a room where everything came up from the floor, but the idea didn’t work because blood flows to the floor
- Better handle hypothermia issues
- Easily convert tables (craniotomy table to abdominal table for example)
- Everything radiopaque

Suggested Best Practices

- Electronic board that tracks patients throughout the hospital (Cape Fear has this today)
- The team recently visited a Berlin hospital that had a state-of-the-art OR and practice parallel processing, intubating patients in an adjoining room as the operating room is being cleaned

We will revisit these ideas when we enter our improvement phase. Additionally, the Landstuhl team has agreed to provide feedback on our findings and proposed tests of change.

Visit to Madigan Army Medical Center

Bruce Gewertz, MD, PI, Ben Starnes, MD, and Jennifer Blaha, Project Manager, visited Madigan Army Medical Center in mid-May. We met with the surgical leadership team and discussed the latest improvements that the Madigan team is working on. A great deal was learned about how they are executing on the Team STEPPS program. Additionally, we toured the hospital and simulation center. The Madigan team, including COL Robert Rush, MD, LTC Scott Steele, MD, LTC Niten Singh, MD, LTC Matt Martin, MD, and Linda Casey, the Trauma Coordinator, expressed enthusiasm about their participation in this grant. COL Rush was working on entering the grant details into the Madigan IRB system prior to his three-month deployment that began in late May.

Aim 1, Task E: perform root cause analysis

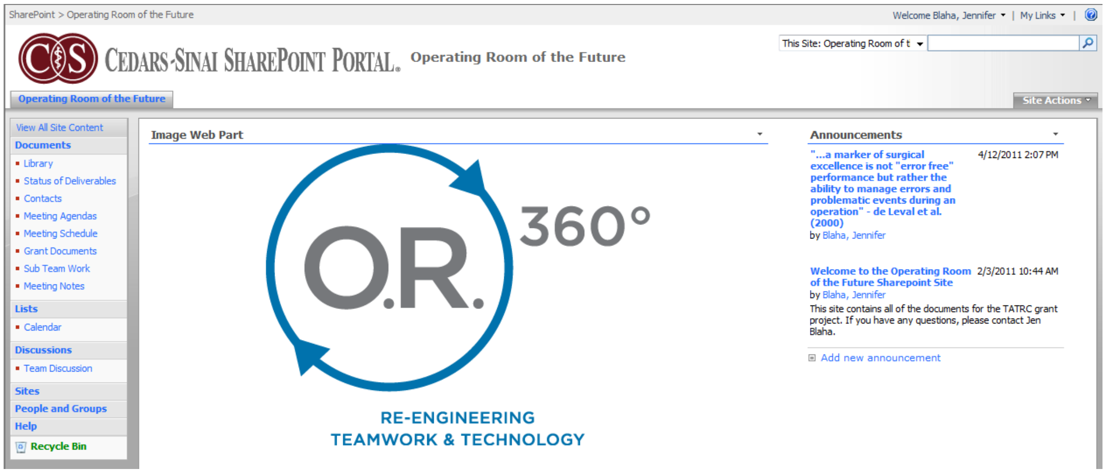
This task will be completed after the prospective observations have been collected and analyzed.

Aim 1, Task F: feedback to current stakeholders

Feedback has been ongoing throughout the first year. We continue to have weekly subgroup meetings, monthly conference calls with the entire collaborative team, as well as bi-annual face-to-face meeting at Cedars-Sinai
We also present to the Cedars-Sinai Trauma Performance Improvement Committee, ED Performance Improvement Committee, and the Department of Surgery Performance Improvement Committee on a regular basis to update the teams on any elements of our research that will affect their respective departments.

Our Sharepoint site (eRoom) houses all of our collaborative documents and allows team members to easily keep up with the latest activities and progress. The site is available to both internal Cedars-Sinai team members as well as our outside collaborators.

Figure 22: Screen Shot of the Collaborative Sharepoint Site



Aim 1, Task G: determine areas of high priority/high impact/high risk

While waiting for approval for the Madigan work and completing the trauma observations, the team began to investigate some of the potential opportunities uncovered so far at Cedars-Sinai. At this time, we are just researching best practices on the topics noted below as we do not want to make process changes that will impact our observational data collection. Moreover, results from the data collection – both qualitative and quantitative – are revealing a great many issues with teamwork, process, flow disruption, safety and quality improvement that will directly inform both the prioritization process and the future development of interventions.

Figure 23: Tests of Change that the Team is Considering

Systems	▪ Standardized briefings / after action reviews ▪ Alter the information conveyed on the trauma pager. Alternatively move to iPhone use and standardize the information exchanges ▪ Standardize the trauma bay layout ▪ Standardize the operating room layout ▪ Copy of the trauma tri-fold goes to the OR with the patient ▪ Parallel processing (improve efficiency) ▪ Pre-operative surgery/anesthesia communication (e.g. timely paging/info) ▪ Intra-operative surgery/anesthesia communication (e.g. about fluids/blood)
Technology	▪ Carrot Medical's C-Com headsets ▪ Smart board with critical information (Robbins, 2011) ▪ Propofol biosensor (Chaum, 2008) ▪ Epidermal electronics – mobile, wireless monitoring (Strauss, 2011)
People	▪ Surgical and nursing coaches (Gawande, 2011)

We have begun to narrow down our scope based on initial data findings. For efficiency, time to intubation, time in the emergency department, time to computed tomography, time in the computed tomography, and time from the emergency department to the operating room are all likely targets. For effectiveness, hospital length of stay, intensive care unit length of stay, hypotensive events, intravenous fluid amount, and blood products transfused are being considered. When all of the flow disruption observation data has been collected and analyzed, we will further narrow our scope to 3 – 4 measures.

Aim 2: Task A: design potential interventions

We have not begun work on this step.

Aim 2, Task B: develop protocols

We have not begun work on this step.

Aim 2, Task C: tests of change in simulation Add text

We have not begun work on this step.

Aim 2, Task D: successful interventions tested and refined at CSMC and partners

We have not begun work on this step.

Aim 2, Task E: findings disseminated as best practices

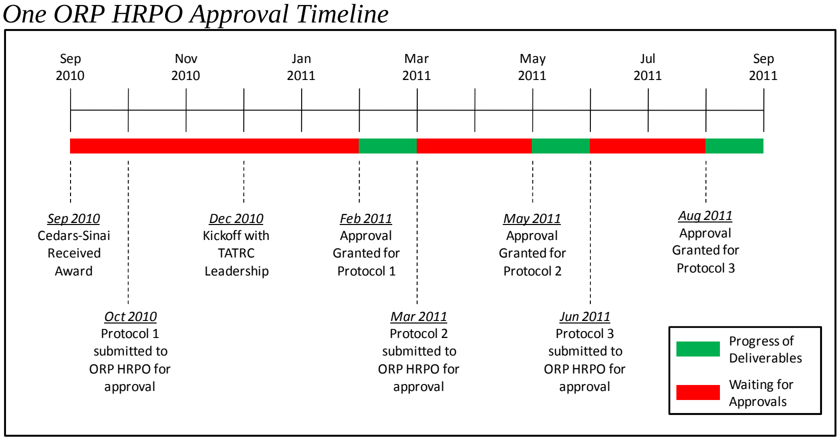
We have not begun work on this step.

Key Research Accomplishments

- Developed an eRoom data sharing site that facilitates collaboration around the country
- Reviewed 32 trauma-related practice management guidelines and summarized them into five process maps
- Spoke to 73 people involved in the trauma process and summarized the findings into actionable output
- Visited Landstuhl Regional Medical Center and Madigan Army Medical Center to strengthen our military connection and ensure that our work will meet the needs of the military
- Trained medical students and PhD candidates in human factors and crew resource management methodologies to prepare them to identify flow disruptions during trauma cases
- To date, we have observed 12 trauma cases and recorded 278 flow disruptions

We would like to note that our progress has been significantly impacted by the delay in ORP HRPO approvals. A complete timeline is included in the appendix (Appendix Document 3: Protocol Approval History), but overall, we have lost over eight months waiting for approvals. For the first protocol, requesting a Database Review, we waited 16 weeks from initial submission by Cedars-Sinai to the ORP HRPO before receiving approval. The second protocol, requesting approval to perform interviews and focus groups, took seven weeks from initial submission to approval. Finally, the latest protocol requesting approval to perform observations, took 11 weeks from initial submission to approval. None of the protocols required significant changes; the delays were explained to be driven by personnel changes and prioritization. After officially kicking off the project in Dec 2010, two months after the award, the additional delays in the approval process have impacted our output. The graphic below shows that during the first year of funding, only three months were spent making progress on the deliverables from the Statement of Work. During the remaining nine months, we were waiting for approval.

Figure 24: Year One ORP HRPO Approval Timeline



Reportable Outcomes

The results of our ongoing research have not been published or reported at national meetings as of this date. We submitted an abstract to the Western Trauma Association's annual conference (Appendix Document 4: Abstract Submitted to Western Trauma Association). A review article detailing the rationale and methods for studying flow disruptions is being written now and will be available for our next report.

Conclusion

In a variety of industrial settings, investigators have used insights from human factors research to optimize the flow of complex work by improving teamwork, technology, training levels or the general work environment. We are using the same methodology to identify and address "flow disruptions" in trauma care in an effort to decrease risk and adverse events. We are using two methods to identify deviations in the normal progression of care: 1) surveys and focus group interviews of experienced care givers (qualitative measures) and 2) direct observation of care progression by trained observers (quantitative measures).

A questionnaire based on standard safety attitude surveys was distributed to physicians, nurses and technicians who provide trauma care. Scores (0-100) were derived along four safety dimensions. The transcribed results of focus group interviews conducted with similar trauma providers were frequency-analyzed to identify situations that hindered performance. Trauma teams activated for high level traumas are now being studied prospectively by trained observers to determine the frequency, cause and impact of flow disruption. Observers follow patients from the ED to ICU, ward, or discharge. A bespoke data collection tablet PC was used to collect data on number, type, timing, and severity of flow disruptions.

<u>Qualitative measures</u>: Survey results from 41 providers suggested positive attitudes to safety, with "speaking up" (71/100) and equipment (76/100) especially positive. Focus group interviews from 73 providers identified coordination (31%) and deviation from trauma protocol (20%) to be the primary sources of flow disruption. <u>Quantitative measures</u>: To date, observers have noted 278 flow disruptions in 12 cases and established coordination between patient care teams (29%), patient related delays (21%), communication (14%) and equipment issues (10%) to be the most common causes. The impact of observed flow disruptions was characterized as none to minimal (78%), moderate (14%) and full case cessation (1%), with the remainder categorized as unknown/missing. A sub analysis of one operative case found 78 disruptions due to patient related delays and coordination problems.

In combination, these qualitative and quantitative assessments build a picture of the complexity of trauma care and a systemic predisposition to error that is richer and more representative than any single source of data. Communication and coordination problems are reported in similar studies but equipment problems and protocol deviations were more frequent in ours. Adverse impact from "flow disruptions" were seen in 15% of observed cases. Appropriate human-centered systemic interventions to reduce flow disruptions during the trauma process may help identify delays, inefficiencies and risks in patient care and improve trauma outcomes.

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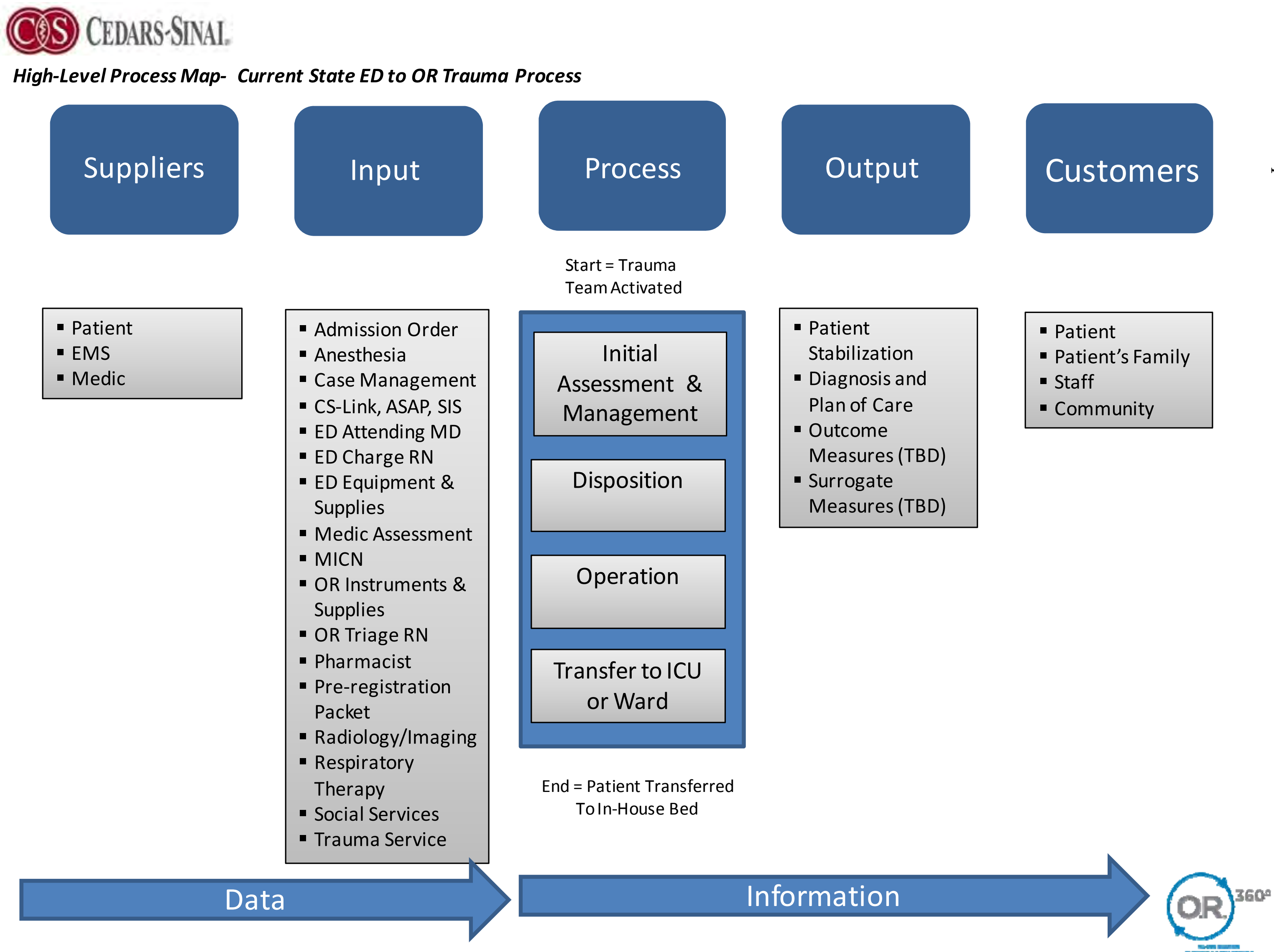
Wiegmann. D.A., ElBardissi, A.W., Dearani, J.A., Daly, R.C., Sundt. Disruptions in Surgical Flow and their Relationship to Surgical Errors: An Exploratory Investigation. *Surgery*, 2007; 142(5), 658-665.

Appendices

Appendix Document 1: Process Maps

High-Level Process Map – Current State ED to OR Trauma Process



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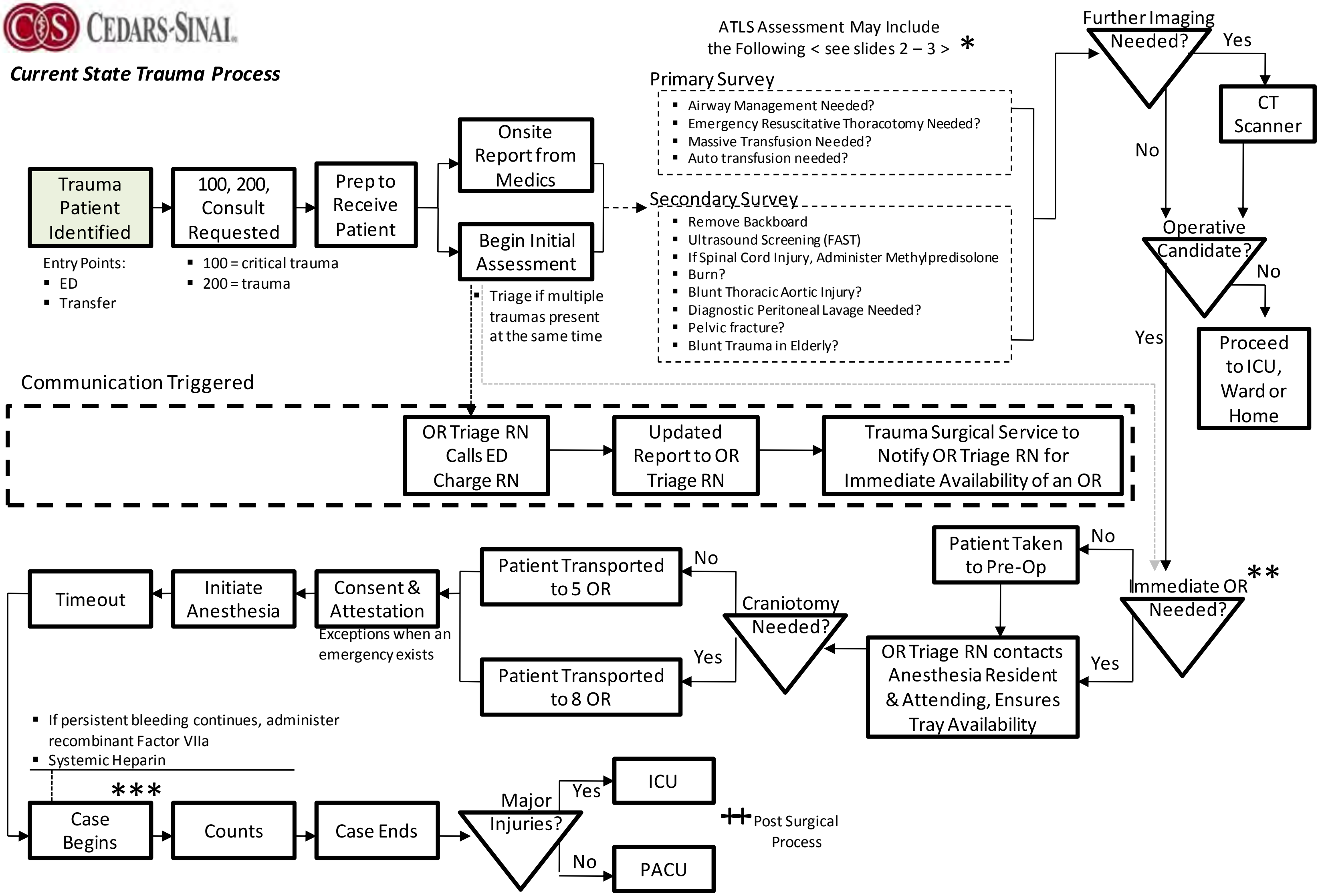
Current State Trauma Process



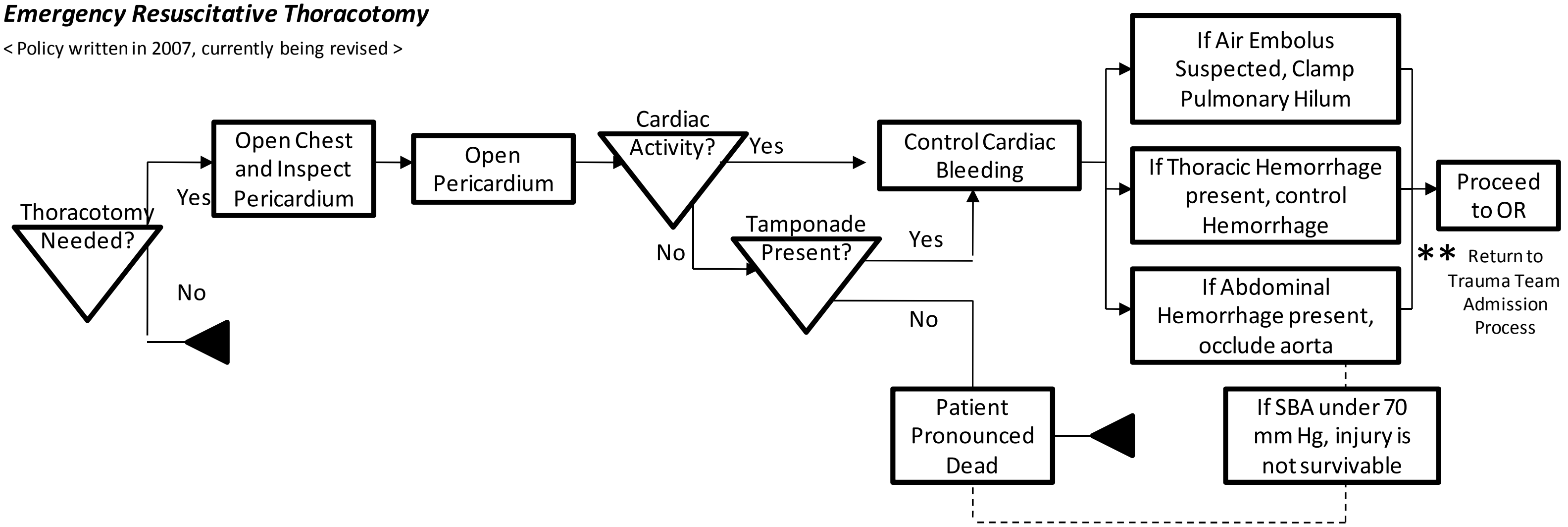
- Primary responsibility of the trauma patient is with the attending trauma surgeon
- Communication with the family must occur when there are significant changes in the patient's condition and after every operation. See "Communication with Family process flow

Current State Trauma Process Map

OR 360°

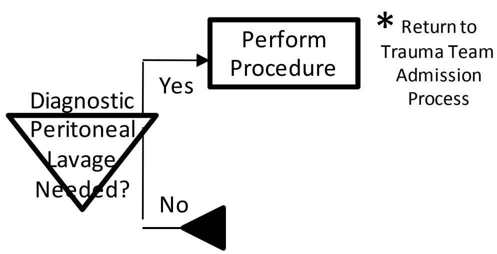
Emergency Resuscitative Thoracotomy

< Policy written in 2007, currently being revised >

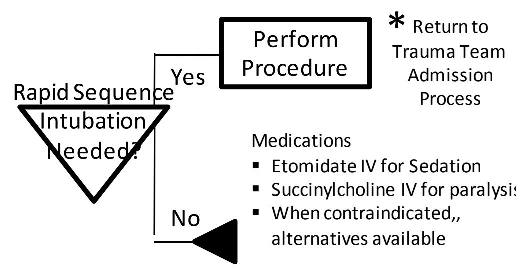


Diagnostic Peritoneal Lavage

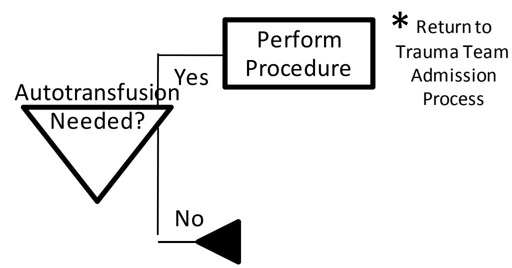
< Use DPAs instead, currently being revised >



Airway Management

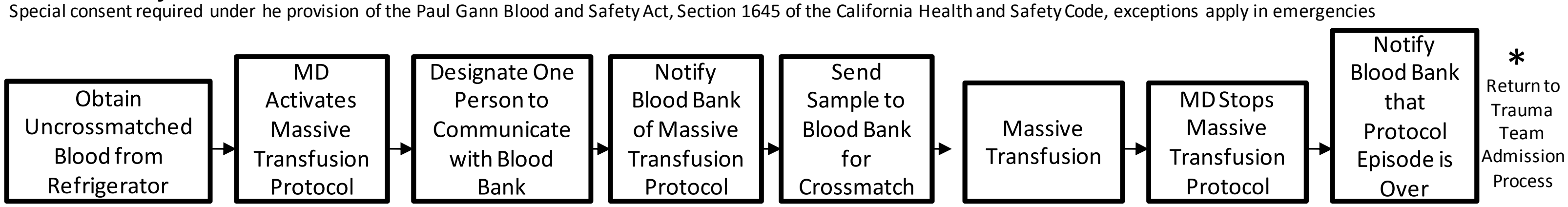


Autotransfusion for the Chest Trauma Patient with Hemothorax

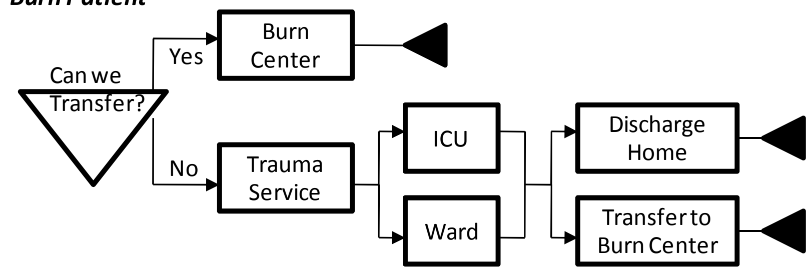


Massive Transfusion Protocol

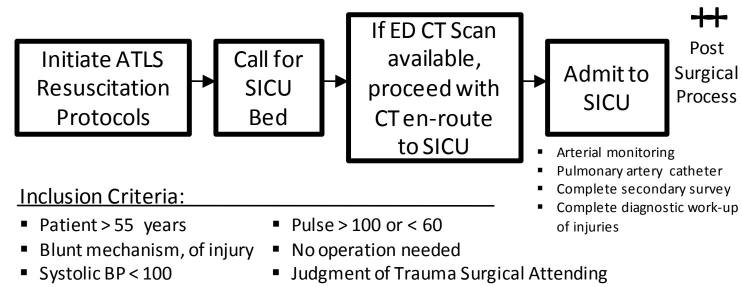
Special consent required under he provision of the Paul Gann Blood and Safety Act, Section 1645 of the California Health and Safety Code, exceptions apply in emergencies



Burn Patient

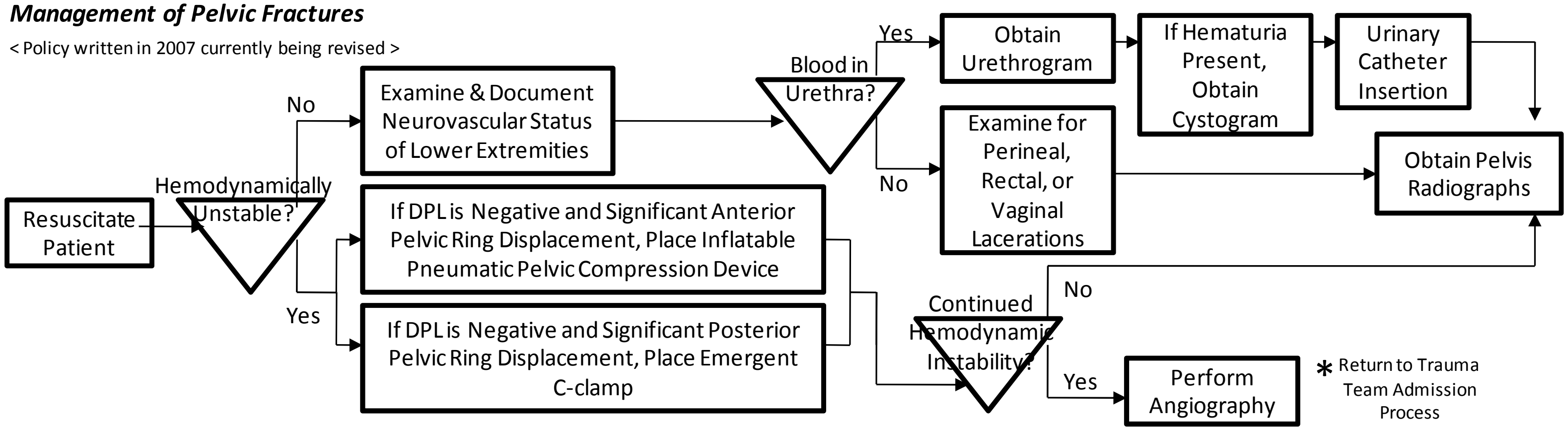


Blunt Trauma and the Elderly Trauma Patient

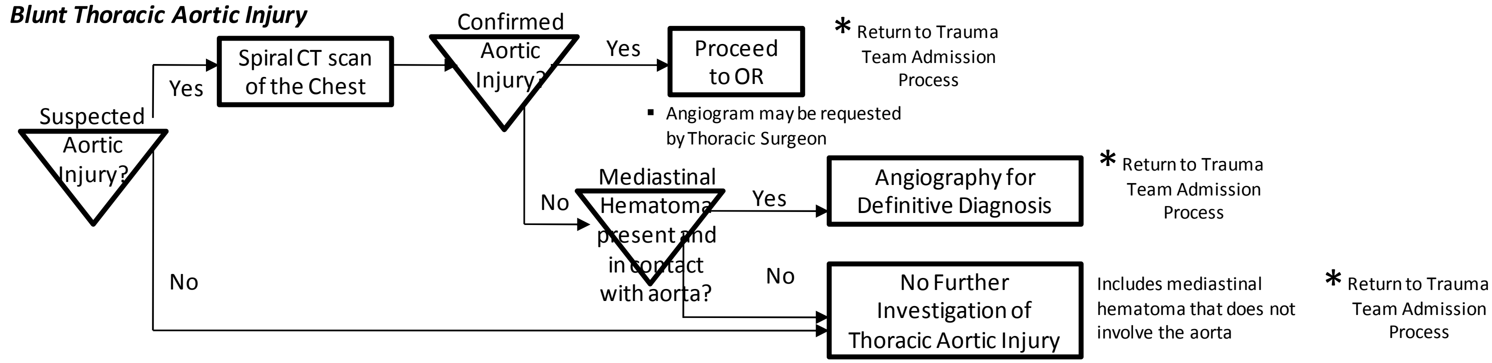


Management of Pelvic Fractures

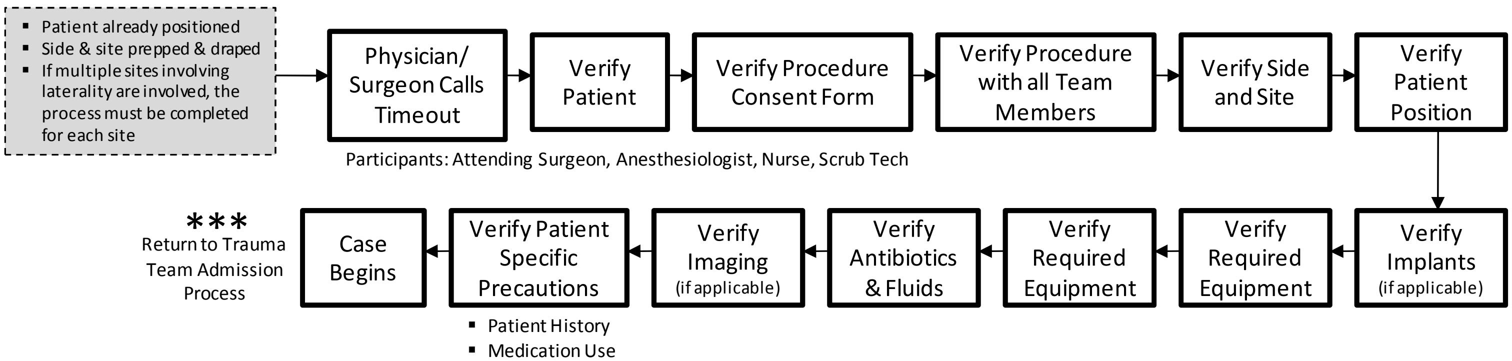
< Policy written in 2007 currently being revised >



Blunt Thoracic Aortic Injury



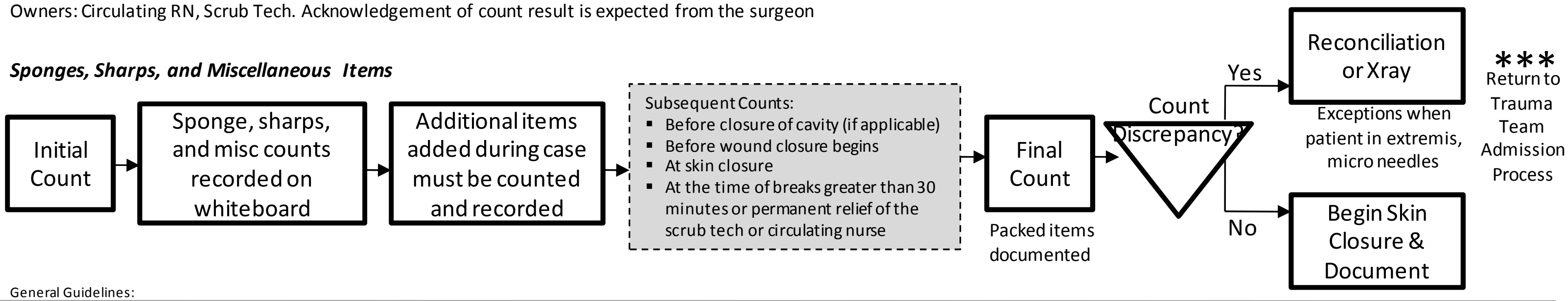
Timeout



Counts: Sponges, Sharps, Instruments, and Special Items

Owners: Circulating RN, Scrub Tech. Acknowledgement of count result is expected from the surgeon

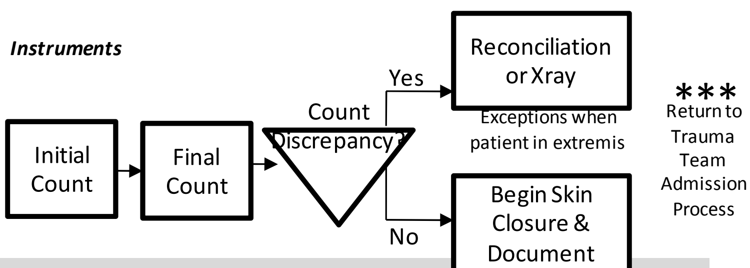
Sponges, Sharps, and Miscellaneous Items

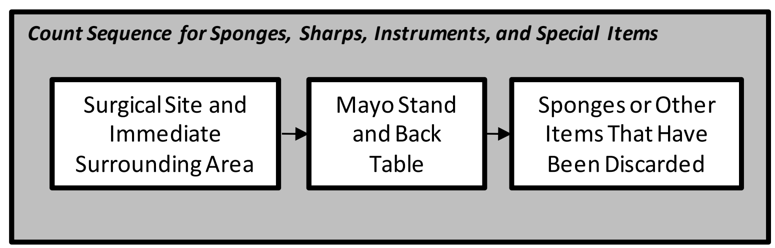


General Guidelines:

- Sponge count bags must be used
- Report from surgeon to surgeon regarding packed sponges when multiple procedures are performed
- When tapes, cottonoids, or sponges are cut, all portions must be accounted for & noted on the white board
- All counted items must remain within the operating room
- Following the initial count, trash and linen bags must remain in the operating room
- Custom pack item lists, sponge wrappers, and suture package should be saved to assist in final count

Instruments





General Guidelines:

- Instruments must be counted by two people for all open cavity cases with an incision greater than two inches and all vaginal procedures
- Disassembled or broken instruments must be accounted for in their entirety

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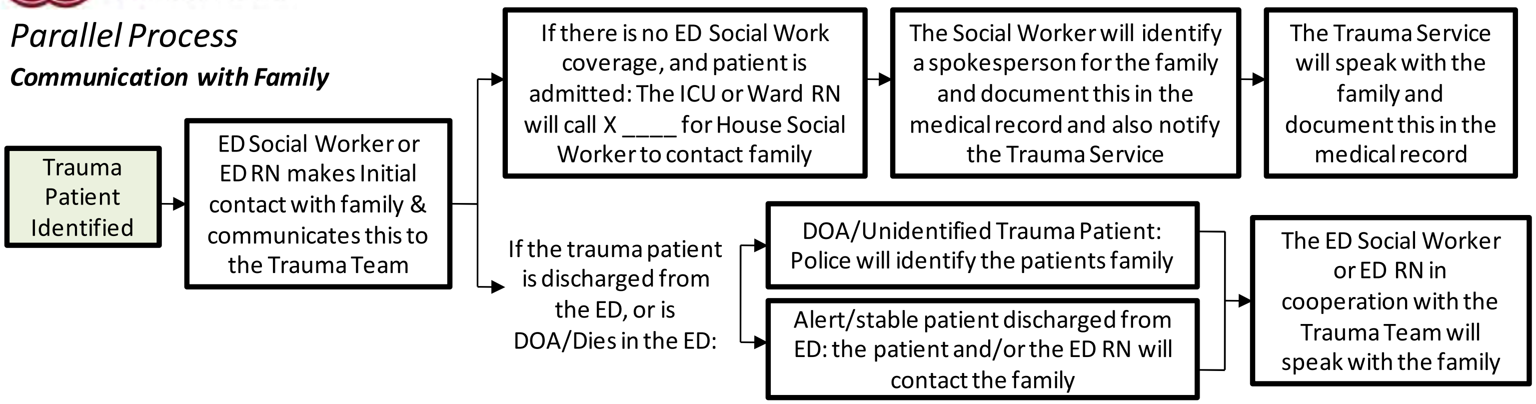
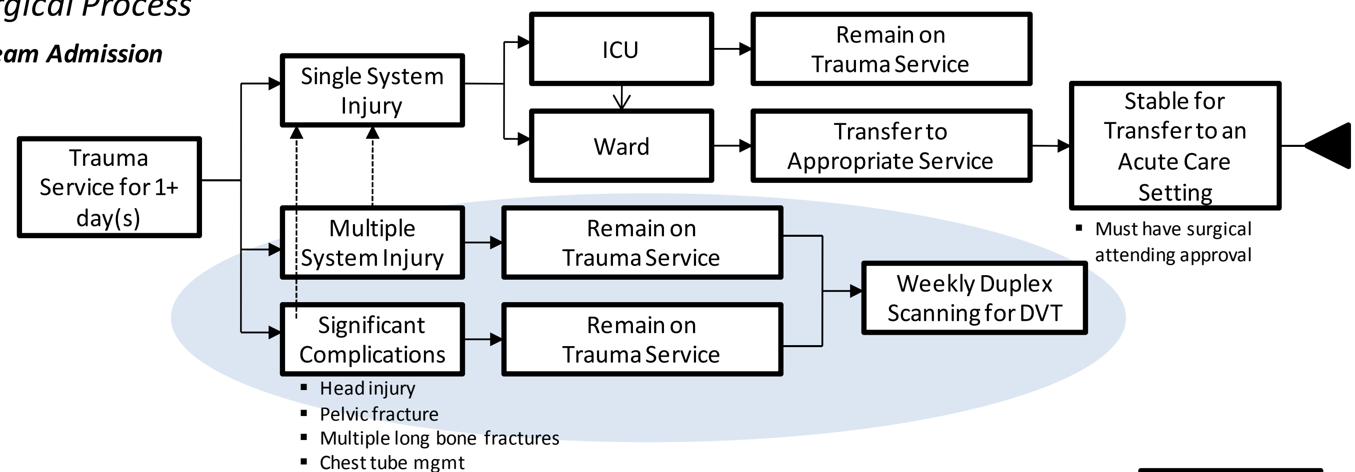
Parallel Process

Communication with Family

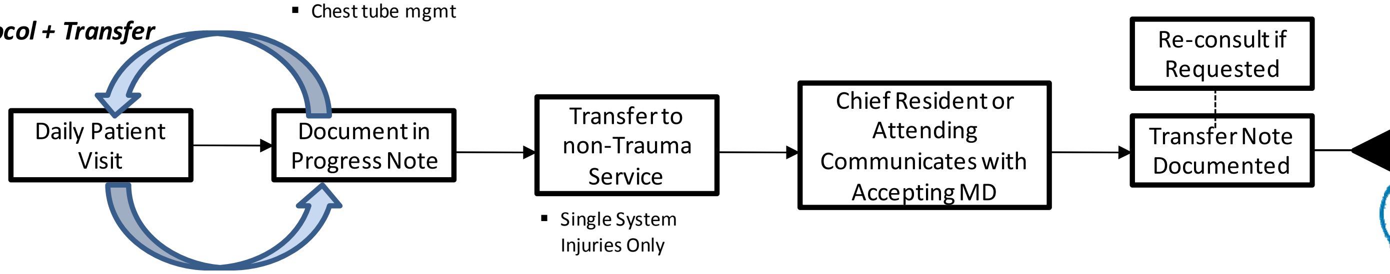


Post Surgical Process ++

Trauma Team Admission

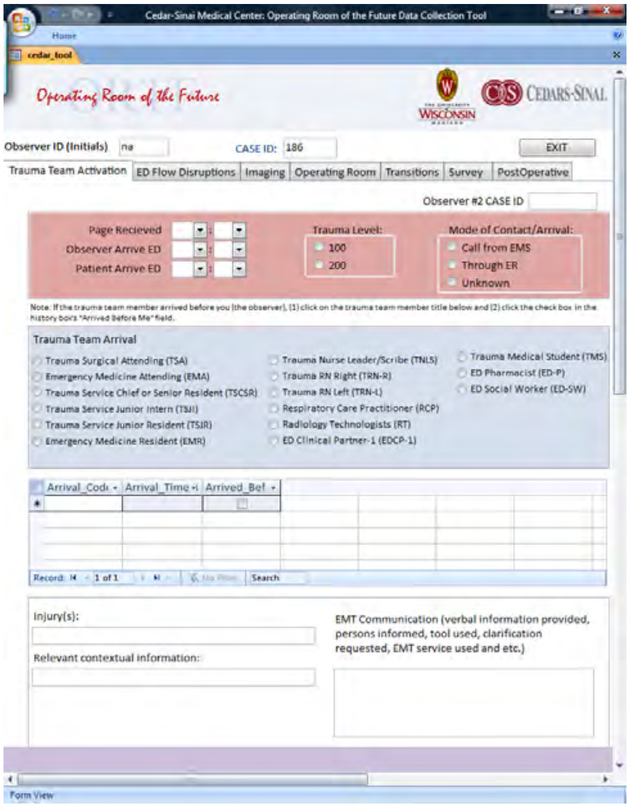


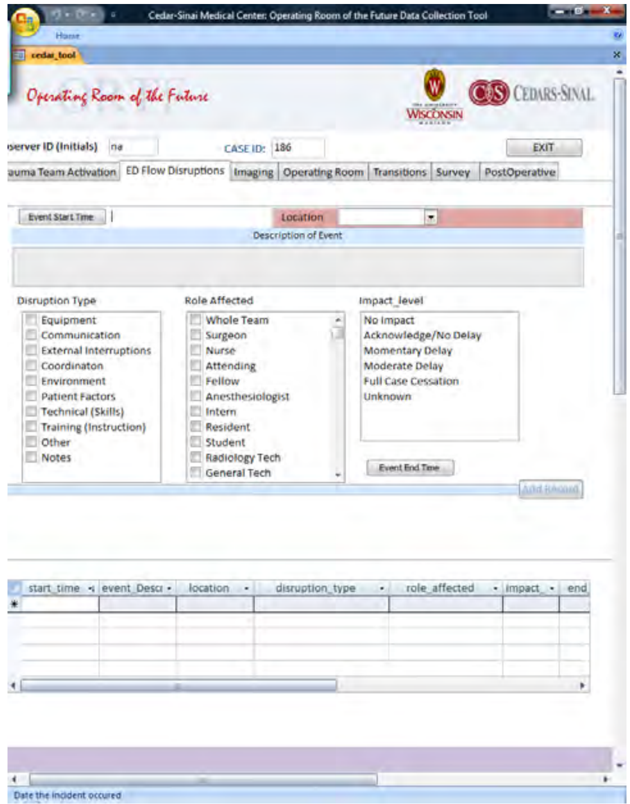
Daily Protocol + Transfer



OR 360°

Appendix Document 2: Tablet PC Data Collection Tool Screen Shots





Appendix Document 3: Protocol Approval History

Protocol 1: Database Review (*16 weeks from submission to approval)*

Process Step	Date
Cedars-Sinai IRB approval	
Submission of protocol to Brigit Ciccarello	
Brigit Ciccarello requested additional documentation and then forwarded the protocol to Brian Garland	October 21, 2010
Additional information requested from Diana Weld	January 14, 2011
Cedars responded with additional information	January 18, 2011
Additional information requested from Diana Weld	January 25, 2011
Cedars responded with additional information	February 1, 2011
Final approval received from HRPO	February 14, 2011

Protocol 2: Focus Groups (*7 weeks from submission to approval)*

Process Step	Date
Cedars-Sinai IRB approval	March 16, 2011
Submission of protocol to Brigit Ciccarello	March 21, 2011
Brigit Ciccarello requested additional documentation and then forwarded the protocol to Brian Garland	March 23, 2011
Additional information requested from Diana Weld	March 28, 2011
Cedars responded with additional information	March 29, 2011
Final approval received from HRPO	May 4, 2011

Protocol 3: Observations (*11 weeks from submission to approval)*

Process Step	Date
Cedars-Sinai IRB approval	June 3, 2011
Submission of protocol to Brigit Ciccarello	June 9, 2011
Brigit Ciccarello requested additional documentation and then forwarded the protocol to Brian Garland	June 13, 2011
Additional information requested from Diana Weld	July 21, 2011
Cedars responded with additional information	July 26, 2011
Final approval received from HRPO	August 28, 2011

Appendix Document 4: Abstract Submitted to Western Trauma Association

Background: In a variety of industrial settings, investigators have used insights from human factors research to optimize the "flow" of complex work by improving teamwork, technology, training levels or the general work environment. We postulated that using such methodology to identify and address "flow disruptions" in trauma care could decrease risk and adverse events. In this study, we used two methods to identify deviations in the normal progression of care: 1) surveys and focus group interviews of experienced care givers (qualitative measures) and 2) direct observation of care progression by trained observers (quantitative measures).

Methods: A questionnaire based on standard safety attitude surveys was distributed to physicians, nurses and technicians who provide trauma care. Scores (0-100) were derived along four safety dimensions. The transcribed results of focus group interviews conducted with similar trauma providers were frequency-analyzed to identify situations that hindered performance. Trauma teams activated for high level traumas were studied then prospectively by trained observers to determine the frequency, cause and impact of flow disruption. Observers followed patients from the ED to ICU, ward, or discharge. Particular focus was given to patients who went directly to the OR. A bespoke data collection tablet PC was used to collect data on number, type, timing, and severity of flow disruptions.

Results: <u>Qualitative measures</u>: Survey results from 41 providers suggested positive attitudes to safety, with "speaking up" (71/100) and equipment (76/100) especially positive. Focus group interviews from 73 providers identified coordination (31%) and deviation from trauma protocol (20%) to be the primary sources of flow disruption. <u>Quantitative measures</u>: Observers noted 278 flow disruptions in 12 cases and established coordination between patient care teams (29%), patient related delays (21%), communication (14%) and equipment issues (10%) to be the most common causes. The impact of observed flow disruptions was characterized as none to minimal (78%), moderate (14%) and full case cessation (1%), with the remainder categorized as unknown/missing. A sub analysis of one operative case found 78 disruptions due to patient related delays and coordination problems.

Conclusion: In combination, these qualitative and quantitative assessments build a picture of the complexity of trauma care and a systemic predisposition to error that is richer and more representative than any single source of data. Communication and coordination problems are reported in similar studies but equipment problems and protocol deviations were more frequent in ours. Adverse impact from "flow disruptions" were seen in 15% of observed cases. Appropriate human-centered systemic interventions to reduce flow disruptions during the trauma process may help identify delays, inefficiencies and risks in patient care and improve trauma outcomes.